Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

Master of Technology
SoE & Syllabus 2019
Structural Engineering

28 June 2019

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2019

Structural Engineering

SN	Sem	Sub Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA	ESE	
I SEMESTER													
1	1	CV3901	Theory of Elasticity and Elastic Stability	T	3	0	0	3	3	30	10	60	3
2	1	CV3902	Structural Dynamics	T	3	0	0	3	3	30	10	60	3
3	1	CV3903	**Lab:** Structural Dynamics	P	0	0	2	2	1	-	40	60	-
4	1	CV3904	Matrix Analysis of Structures	T	3	0	0	3	3	30	10	60	3
5	1	CV3905	**Lab:** Matrix Analysis of Structures	P	0	0	2	2	1	-	40	60	-
6	1	CV3906	Design of Substructures & Foundations	T	3	0	0	3	3	30	10	60	3
7	1	CV3907	Earthquake and wind effects on Structures	T	3	0	0	3	3	30	10	60	3
8	1	CV3908	Advanced Concrete Structures	T	3	0	0	3	3	30	10	60	3
9	1	CV3909	**Lab:** RCC Design Studio	P	0	0	2	2	1	-	40	60	-
Total					**18**	**0**	**6**	**24**	**21**				
II SEMESTER													
1	2	CV3915	Finite Element Method	T	3	0	0	3	3	30	10	60	3
2	2	CV3916	**Lab:** Finite Element Method	P	0	0	2	2	1	-	40	60	-
3	2	CV3917	Theory of Plates and Shells	T	3	0	0	3	3	30	10	60	3
4	2	CV3918	Advanced Steel Structures	T	3	0	0	3	3	30	10	60	4
5	2	CV3919	**Lab:** Steel Design Studio	P	0	0	2	2	1	-	40	60	-
6	2		Professional Elective-I	T	3	0	0	3	3	30	10	60	3
7	2		Professional Elective-II	T	3	0	0	3	3	30	10	60	3
8	2		Professional Elective-III	T	3	0	0	3	3	30	10	60	3
Total					**18**	**0**	**4**	**22**	**20**				

List of Professional Electives-I

2	CV3920	PE I: New Engineering Materials
2	CV3921	PE I: Prestressed Concrete
2	CV3922	PE I: Smart Structures and Applications

List of Professional Electives-II

2	CV3923	PE II: RC Tall Buildings
2	CV3924	PE II: Composite Strucutres
2	CV3925	PE II: RC Bridge Design

List of Professional Electives-III

2	CV3926	PE III: Plastic Analysis and Design of Structures
2	CV3927	PE III: Seismic Analysis and Design of Structures
2	CV3928	PE III: Design of Industrial Structures

SN	Sem	Sub Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA	ESE	ESE Duration Hours
III SEMESTER													
1	3	CV3939	Project Phase-I	P	0	0	12	12	6	-	100	-	-
Total					**0**	**0**	**12**	**12**	**6**				
IV SEMESTER													
1	4	CV3940	Project Phase-II	P	0	0	20	20	10	-	40	60	-
Total					**0**	**0**	**20**	**20**	**10**				
Total Credits									**57**				

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

		June 2019	1.00
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**

Applicable for Sem 1 & 2 AY 2019-20 & Sem 3 & 4 AY 2020-21 Onwards

1st SEMESTER

CV3901	Theory of Elasticity and Elastic Stability	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To impart knowledge of various theories of elasticity and apply them to solve 2D and 3D stress analysis 2. To demonstrate various theories of bending and torsion and apply them to solve 2D problems 3. To understand the concept of elastic stability of individual elements 4. To apply the concept of elastic stability to beam-column, column and built up column	After the completion of the course, the student should be able to 1. Demonstrate the knowledge of fundamental methods of elasticity for 2-D and 3D stress analysis 2. Analyze bending and torsional problems and apprise various theories to solve 2-D problems 3. Apply the basic knowledge of elastic stability to various structural elements 4. Explain and solve the problems of beam-column, column and built up column using the concept of elastic stability
PO Mapped: 3,4	

UNIT- I Introduction to Two Dimensional Stress Analysis, Types of forces, Components of stresses and strains, Stress-strain relation, Plane stress and plane strain, Strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress function.	**[07 Hrs.]**
UNIT- II Introduction to Three Dimensional Stress Analysis, Components of stress, Principal stresses, Stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.	**[06 Hrs.]**
UNIT- III Bending of cantilever of narrow rectangular section loaded at end, bending of simply supported beam with uniform load, torsion of non-circular and elliptical cross section.	**[06 Hrs.]**
UNIT- IV Differential equation for beams columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral buckling of beams.	**[07 Hrs.]**
UNIT- V Energy method for elastic bucking of columns, Approximate method, Buckling of Columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with varying cross section.	**[07 Hrs.]**
UNIT- VI Effect of shearing force on critical load, Buckling of built up columns, Buckling of simply supported rectangular plates uniformly compressed in middle plane.	**[06 Hrs.]**

Text Books

1. Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, 3rd Edition, Mc-Graw Hill Book Company, New Delhi, 1963
2. Timoshenko, S.P. and Gere J. M., Theory of Elastic Stability , 2nd Edition, Mc-Graw Hill Book Company, New Delhi,1963

Reference Books

1. Srinath, L.S., Advanced Mechanics of Solids India, 2nd Edition, Tata Mc-Graw Hill Book Company, 2003.
2. Ameen, M., Computational Elasticity—Theory of Elasticity, Finite and Boundary Element Methods, 1st Edition, Narosa publication, 2007
3. Mikhait Filonenkoborodich, Theory of Elasticity, 1st Edition, University press of pacific, 2003

1st SEMESTER

CV3902	Structural Dynamics	L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems. 2. To provide the students clear and thorough understanding of Calculation of the mode shapes and frequencies for the free response of continuous vibratory systems and use modal methods to calculate the forced response of these systems. 3. To provide the students understanding of modeling continuous vibratory systems – vibration of strings, axial and torsional vibration of bars and beams. 4. To provide the student with a basic understanding of IS codes related to earthquake loading.	1. An ability to apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response. 2. Ability to identify, formulate and solve engineering problems having motions varying with time. This will be accomplished by having students model, analyze and modify a vibratory structure, in order to achieve specified requirements. 3. Understanding professional and ethical responsibilities. This will be accomplished by emphasizing the importance of understanding how structural vibrations may affect safety and reliability of engineering systems. 4. An ability to Understand IS codes related to earthquake loading.
PO Mapped: 1,2,3	

UNIT - I Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped single degree freedom systems.	**[07 Hrs.]**
UNIT - II Response of single degree freedom systems to harmonic loading, support motion and transmissibility, Duhamel's integral.	**[06 Hrs.]**
UNIT - III Multiple degree of Freedom system: Vibration of undamped 2 DOF systems; Response of 2 DOF to harmonic excitation, mode superposition, vibration absorber, Free vibration of MDOF (up to 3 DOF) systems, Dynamic response of MDOF (2 DOF) systems-modal superposition method. Energy Principle, Rayleigh's method (2 DOF)	**[06 Hrs.]**
UNIT - IV Dynamic analysis of systems with distributed properties, Approximate design method, Transformation factors.	**[06 Hrs.]**
UNIT – V Response spectra, generation and types of response spectra, Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars / beams. Response of continuous systems to dynamic loads.	**[07 Hrs.]**
UNIT - VI Introduction to vibrations due to earthquake, Study of IS 1893 applicable to Buildings and Water Tanks.	**[06 Hrs.]**

Text Books:

1. Mario Paz, Structural Dynamics Theory & Application, CBS Publ.; N-Delhi, 1995.
2. Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2nd Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995

Reference Books:

1. Clough / Penzien, "Dynamics of Structures", McGraw Hill, 1993
2. Humar, J. L., "Dynamics of Structures", Prentice Hall, 1993
3. Timoshenko, S., "Advanced Dynamics", McGraw Hill Book Co; NY, 1948
4. Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill; NY, 1964
5. Damodarasamy and Kavitha," Basics of structural Dyanamics and Aseismic design, Phi Publisher, New Delhi.

1st SEMESTER

CV3903	Lab : Structural Dynamics		L=0	T=0	P=2	Credits = 1
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**	**ESE Duration**	
	-----	**40**	**60**	**100**	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free response of these systems. 2. To provide the students clear and thorough understanding of damping of systems and their relevance 3. To demonstrate phenomenon of soil liquefaction and mode shapes in water medium 4. To provide the students clear and thorough understanding of IS codes related to earthquake loading for buildings and elevated water tanks	1. An ability to understand the behavior of vibratory system during cyclic loading. 2. An ability to understand phenomenon like damping and its relevance in actual structural applications. 3. An ability to understand the effect of earthquake phenomenon on water media and subsoil. 4. An ability to understand provision of various Indian standards for design of structures from seismic safety point of view.
PO Mapped: 1,2,3	

PRACTICALS

1. To study various instruments for imparting dynamic forces.
2. To study various instruments for the response of vibrating structure.
3. To study the response of a single degree of lumped mass system subjected to base excitation.
4. To study the response of a two degree of freedom system building frame subjected to base motion.
5. To study the response of a multi degree of lumped mass system.
6. Verification of natural frequency of SDOF model under free vibration.
7. To study the liquefaction of soil structure.
8. To study the Earthquake induced waves in rectangular water tank.
9. To calculate horizontal seismic force of building using IS-1893.
10. To calculate the lateral forces in water tank due to Earthquake when water tank is empty and water tank is full by IS-1893.

1st SEMESTER

CV3904	Matrix Analysis of Structures	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
Students will be introduced to 1. Understand basic concepts of stiffness method of matrix analysis. 2. Analyze the structures using stiffness method. 3. Apply software of structural analysis based on this method.	Students will be able to 1. Understand the different types of structures 2. Apply the matrix stiffness method to model the behavior of planar trusses, beams, and frames; 3. Analyze any multistoried building using Matrix Stiffness methods of structural analysis. 4. Recognize special effects on behavior of structures. 5. Implement the method developing their own computer program to analyze structures.
PO Mapped: 1,3,4	

UNIT - I Introduction to stiffness and flexibility approach, Stiffness matrix for spring, Bar, torsion, Beam (including 3D), Frame and Grid elements, Displacement vectors, Local and Global co-ordinate system, Transformation matrices, Global stiffness matrix and load vectors, Assembly of structure stiffness matrix with structural load vector, application to spring and bar problems.	**[07 Hrs.]**
UNIT - II Analysis of Plane Truss, Space Truss by Stiffness Method	**[06 Hrs.]**
UNIT - III Analysis of Beam, Plane Frame, Space Frame by Stiffness Method	**[06 Hrs.]**
UNIT - IV Analysis of building systems for horizontal loads, Buildings with and without rigid diaphragm, various mathematical models and introduction to Solution techniques.	**[07 Hrs.]**
UNIT - V Analysis of Plane Grid by Stiffness Method	**[06 Hrs.]**
UNIT - VI Analysis for member loading (self, Temperature & Imposed) Inclined supports, Lack of Fit, Initial joint displacements. Effect of shear deformation, internal member end releases	**[07 Hrs.]**

Text Books:-

1. Gere, W. and Weaver; J. M., Matrix Method of Structural Analysis 3rd Edition, Van Nostrand Reinhold; New York; 1990
2. Meghre A.S.& Deshmukh S.K. ; Matrix Method of Structural Analysis, 1st edition, Charotar publishing house, Anand, 2003
3. Kanchi, M. B., Matrix Method of Structural Analysis, 2nd Edition; John Willey & Sons, 1999
4. Godbole P., Sonparote R., Dhote S. Matrix Methods of Structural Analysis, PHI Learning Pvt. Ltd. 2014

Reference Books:-

1. Cheng, F.Y., M. Dekke; Matrix Analysis of Structural Dynamics, NY 2000
2. Bathe, K.J., Finite Element Procedures, 2nd Edition Springer,; 2002
3. Cook, R.D Concepts and Applications of Finite Element Analysis, et. al, John Willey &Sons; NY 1995
4. Martin; H.C., Introduction to Matrix Method of Structural Analysis, McGraw Hill Book Co. 1966
5. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991
6. Kassimali A., Matrix Analysis of Structures SI Version, Cengage Learning, 2011
7. Livesley R. K. Matrix Methods of Structural Analysis: Pergamon International Library of Science, Technology, Engineering and Social Studies, Elsevier, 2013
8. McGuire W. Gallaghar R. H. & Zimian R. D., Matrix Structure Analysis. John Willey Publication
9. Przemieniecki J. S., Theory of Matrix Structural Analysis, Dover Publication Inc. New York

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1st SEMESTER

CV3905	Lab : Matrix Analysis of Structures		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**		**ESE Duration**
	-----	**40**	**60**	**100**		-----

COURSE OBJECTIVE	COURSE OUTCOMES
Students will be introduced to 1. Develop models of various structures in the software package, and apply the required properties, boundary conditions and forces in the developed models. 2. Analysize various structural elements by stiffness method of structural analysis. 3. Execute computer program using standard software package without any error. 4. Compare results between manual analysis and software package analysis.	Students will be able to 1. Apply the stiffness method for structural analysis. 2. Analyze continuous beams, plane truss, space truss, plane frame neglecting axial deformation, plane frame considering axial deformation, plane grids. 3. Recognize special effects on behavior structures.
PO Mapped: 1,3,4	

1. Analyze a continuous beam with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
2. Analyze a continuous beam with sinking of support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
3. Analyze a plane truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method. Conclude it from both the result.
4. Analyze a plane truss subjected to inclined roller support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
5. Analyze a plane truss subjected to temperature effect and lack of fit with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
6. Analyze a space truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
7. Analyze a plane frame with maximum three degree of Kinematic Indeterminacy, using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
8. Analyze a plane grid using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
9. Analyze a multi storied frame structure subjected to horizontal forces using software package.

1st SEMESTER

CV3906	Design of Substructures and Foundations	L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students knowledge of different types of foundation structures. 2. To provide the students knowledge of different types of loading applied on foundation structures. 3. To provide the students knowledge of different methods used for the analysis of foundation structures. 4. To provide the students, knowledge of different codal provisions applicable to advanced design of foundation structures. 5. To provide the students knowledge of design of deep foundation systems, machine foundations etc.	1. Students will be able to identify the type of foundations to be used for various site conditions 2. Students will be able to analyze and design different types of foundation structures. 3. Students will be able to draw RCC detailing and to prepare working drawing. 4. Students will be able to understand the importance of various codes used for different types of foundation structures.
PO Mapped: 1,3,4,6	

UNIT – I Introduction to soil structure interaction, Bearing Capacity of Foundations, Theories, In-situ tests; Settlement Analysis, factors affecting settlement, control of excessive settlements; Soil classification, Geotechnical design parameters. Design of different isolated footings including eccentrically loaded footings.	**[07Hrs.]**
UNIT – II Design of combined footing and design of raft foundation.	**[06 Hrs.]**
UNIT – III Analysis and design of pile foundation, Function and Classification of piles, Static point and skin resistance capacity of a Pile, pile load tests, Pile settlements, design of RCC piles, Various pile group patterns, Efficiency of Pile in group, Negative skin friction, Pile Cap design, Under reamed pile foundation, Introduction to design of well foundation. IS 2911 Part I to Part V	**[07 Hrs.]**
UNIT – IV Introduction to machine foundations and its practical considerations for construction IS code of practice, introduction to analysis and design of simple machine foundation. Theory of sub grade reaction, beam on elastic foundation.	**[06 Hrs.]**
UNIT – V Ground improvements: Various methods, sand drains, stone columns, stabilization, grouting, reinforced earth, geotextiles, diaphragm walls, Reinforced earth retaining walls, skin walls.	**[06 Hrs.]**
UNIT – VI Analysis and design of Cantilever, counter fort and basement retaining walls and abutments.	**[07 Hrs.]**

Text Books

1. Sawmi Saran, " Analysis and Design of Substructures", , Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Kurain N. P," Design of foundation systems- Principles and Practice", Narosa Publishing house, New Delhi, 2005.
3. Poulose H.G. and Davis E.H.," Pile foundation Analysis and Design", John-Wiley Sons, NY, 1980.
4. Karuna Moy Ghosh , "Foundation Design in practice", PHI Learning Pvt. Ltd, New Delhi 2012
5. P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.

References Books

1. J. E. Bowles, "Foundation Analysis and Design", Tata McGraw Hill New York
2. Kurain N.P," Modern Foundations: Introduction to Advance Techniques", Tata McGraw Hill, 1982
3. Winterkorn H.F. and Fang H.Y. Ed., "Foundation Engineering Hand Book", Van-Nostrand Reynold, 1975
4. Bowles J.E., "Foundation Analysis and Design" (4th Ed.), Mc.Graw –Hill, NY, 1996
5. Sreenivasalu&Varadarajan, "Handbook of Machine Foundations", Tata McGraw Hill
6. Hetenyi, M. "Beam on Elastic Foundation", University of Michigan Press, 1946.
7. Swami Saran, "Soil Dynamics and machine Foundations", Galgotia Publications (P)Ltd, New Delhi, 1999.

1st SEMESTER

CV3907	Earthquake and Wind Effects on Structures	L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVES	COURSE OUTCOMES
After completion of syllabus students will able to 1. Understand basic concepts of earthquake engineering 2. Understand behavior of structural components under earthquake and wind loading 3. Understand concepts of earthquake resistance design 4. Understand various standers & specification related to earthquake and wind effects on structures 5. Understand Wind Characteristics and concept of Mathematical Modeling.	1. An ability to apply the knowledge of geological feature, plate tectonics in understanding occurrence of earthquake. 2. An ability to understand causes and sources of earthquake damages and possible response of structure and system to earthquake. 3. An ability to understand characteristics of wind and its static and dynamic effects on structures 4. An ability to understand relevant I.S. codes and philosophy in design of earthquake& Wind resistant structure
PO Mapped: 1,3,4,5	

UNIT – I Origin of earthquake, Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake (magnitude, & intensity of earthquake), Measurement of earthquake (accelerograph, accelogram recording and analysis of earthquake records), determination of magnitude, epicenter distances, Seismicity of the world.	**[07 Hrs.]**
UNIT- II Causes or sources of earthquake damage, damage due to ground failure, History of past Earthquakes, generation of response spectrum from available earthquake records, Earthquake design spectrum and inelastic spectrum. Evolution of seismic risk.	**[07 Hrs.]**
UNIT – III Concepts of earthquake resistance design, Design philosophy, and four virtues of earthquake resistance design (stiffness, strength, ductility and configuration). Introduction to capacity design concept, Study of IS: 1893, Study of IS: 13920 for analysis and ductile design of RCC structures.	**[06 Hrs.]**
UNIT – IV Wind Characteristics: Historical Wind Speed Data, Wind Speed Map of India, Cyclones and Tornadoes.	**[05 Hrs.]**
UNIT-V Static Wind effects and Building Codes with particular reference to IS – 875 (Part III).	**[07 Hrs.]**
UNIT-VI Dynamic Wind Effects: Wind Induced Vibrations, , Analysis for dynamic wind loads, Vibration Control and Structural Health Monitoring.	**[07 Hrs.]**

Text Books:

1. Kramer, S.L, "Geotechnical Earthquake Engineering", Prentice Hall, New Jersey, 1996.
2. Arya A. S., "Introduction to earthquake engineering structures".
3. C. Scruton, "An Introduction to Wind Effects on Structures", Oxford University Press, Oxford, UK., 1981

1st SEMESTER

CV3907	Earthquake and Wind Effects on Structures		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs *	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Reference books

1. Murthy, C.V.R, "Earthquake tips", IIT Kanpur documents.
2. Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2nd Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995
3. Dowrick, D.J, "Earthquake Resistant Design for Engineers and Architects", 2nd Edition; 1987
4. Peter Sachs, "Wind Forces in Engineering", Pergamon Press. Oxford UK, 1972
5. Lawson T. V., "Wind Effects on Buildings", Applied Science Publishers, London, UK, 1980
6. Emil Simiu and R. H. Scanlan, "Wind Effects on Structures – An Introduction to Wind Engineering", John Wiley and Sons, New York., 1986
7. Cook, N. J., The designer's guide to wind loading of building structures. Part 1 Background, damage survey, wind data and structural classification. Building Research Establishment, Butterworths, U. K., 1985
8. Cook, N. J., Designer's guide to wind loading of building structures. Part 2: Static structures. Building Research Establishment, Butterworths, U. K., 1990
9. Simiu, E., Scanlan, R. H. Wind Effects on Structures: fundamentals and applications to design. 3rd Edition., John Wiley & Sons, New York, 1996.
10. Dyrbye, C., Hansen, S. O., Wind loads on structures., John Wiley, New York, 1997

Reference IS codes:

IS 1893-2016 Part I Earthquake criteria
IS 13920-2016 ductile detailing

1st SEMESTER

CV3908	Advanced Concrete Structures		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVES	COURSE OUTCOMES
After completion of syllabus students will able to get the knowledge about the design of 1. Bridges. 2. Water tanks. 3. Multistoried buildings. 4. Silos & Bunkers.	1. An Ability to know provisions of relevant IS codes / IRC code required for design of advanced concrete structures such as water tank, bridges ,multistoried building 2. An ability to design advanced concrete structures such as water tank , bridge and culvert 3. An ability to understand the various methods of design of multistoried buildings, retaining wall. 4. An ability to draw RCC detailing of structures.
PO Mapped: 01, 03, 04, 05,	

UNIT – I Analysis and design of Multistoried buildings, calculation of loads, Approximate analysis, Preliminary sizing,	**[07 Hrs.]**
UNIT – II Design of circular water tanks resting on ground.	**[06 Hrs.]**
UNIT – III Analysis and Design of Elevated water tank including design of supporting system	**[07 Hrs.]**
UNIT – IV Study of different types of IRC loading and IRC Recommendations	**[06 Hrs.]**
UNIT – V Analysis, Design & Detailing of bridges and Culverts. IRC Recommendations	**[07 Hrs.]**
UNIT – VI Analysis and design of, Silos, and Bunkers	**[06 Hrs.]**

Text Books:

1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition - 2006
2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

Reference Books:

1. Johnson and Victor, "Essentials of Bridge Engineering" Oxford and IBH publisher, 1980
2. Jain O.P. and Jai Krishna, Plain and Reinforced concrete structures–Volume –II, Nemchand and brothers, 1987
3. Chattergee, B K, "Theory and design of Concrete Shells" Oxford and IBH publisher, 1978
4. Chen, W.F. and Duan, L. "Bridge engineering Handbook"

1st SEMESTER

CV3909	Lab : RCC Design Studio		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**		**ESE Duration**
	-----	**40**	**60**	**100**		-----

COURSE OBJECTIVES	COURSE OUTCOMES
1. To provide the students clear & thorough understanding of IS code related to reinforced concrete structures. 2. To provide the students clear & thorough understanding of reinforcement of essential parts of R. C. structures as per SP 34. 3. To provide the knowledge to understand the comparison of results between manual analysis & design and software analysis & design of simple member of R. C. structure.	1. An Ability to know provisions of relevant IS codes / IRC code required for design of advanced concrete structures such as water tank, bridges ,multistoried building 2. An ability to design advanced concrete structures such as water tank , bridge and culvert 3. An ability to understand the various methods of design of multistoried buildings. 4. An ability to draw RCC detailing of structures
PO Mapped: 01, 03, 04, 05,	

PRACTICALS

1. Review of IS 456, IS 962 Basics of Limit State Design (Beams, Columns, Slabs) Design of Multistoried buildings
2. Design for axial force, flexural, shear and combined effects Slabs (one way & two way) and slabs on grades. Preliminary sizing, modeling, designing & detailing of R. C. C. structures
3. Design of Bunker/ Design of Bridge (Any One)

Reference Books:

1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, I st edition – 2006
2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005.

2nd SEMESTER

CV3915	Finite Element Method		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the student with knowledge and analysis skills in applying basic laws and steps used in solving the problem by finite element method. 2. To provide the student the knowledge of various interpolation functions and elements to solve simple problems by finite element method. 3. To provide the student the knowledge of is oparametric transformation. 4. To provide students the knowledge of mathematical modelling techniques. 5. To develop the student's skills in applying FEM solution steps by using software.	1. An ability to derive element matrix equation by different methods by applying basic laws in structural analysis. 2. An ability to apply the knowledge of finite element method to solve simple problems. 3. An ability to extend the knowledge of finite element method to solve complex problems using various elements. 4. An ability to understand solution and modeling techniques used in finite element method.
PO Mapped: 3, 4,	

UNIT – I Principles and discretization, Elements stiffness formulation based on direct and, variational techniques, Rayleigh Ritz Method for Bar and Beam analysis.	**[06 Hrs.]**
UNIT – II Shape functions, Finite Element Formulation using Cartesian Coordinates, Application to 1D problems, Convergence criteria.	**[07 Hrs.]**
UNIT – III Triangular and Rectangular element formulation using Cartesian Coordinates, Application to 2D stress analysis.	**[06 Hrs.]**
UNIT – IV Natural coordinates, Isoparametric elements, Application to 1D Problems, Isoparametric elements for two-dimensional stress analysis.	**[07 Hrs.]**
UNIT – V Shape Functions for three Dimensional Stress analysis, Axi-symmetric Stress Analysis.	**[07 Hrs.]**
UNIT – VI Modelling techniques and solution techniques, Computer Implementation of FEM Procedure for 1D & 2D problems, Numerical integration.	**[06 Hrs.]**

Text Books:

1. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991
2. Rajasekaran S, Finite Element Analysis in Engineering Design, S. Chand &Co. Ltd. New Delhi, 1999.

Reference Books:

1. Zienkiewicz O.C. and Taylor R.L., The Finite Element Method (Volume -I), 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1989
2. Cook R. D. , Concepts and Applications of Finite Element Analysis, 3rd Edition, Wiley India Text books, Wiley India Pvt. Limited, New Delhi, 1989.
3. Krishnamurthi C.S., Finite Element Analysis: Theory and Programming , 2nd Edition, Tata McGraw Hill Publishing Company Limited, 1994, Reprint 2005.
4. Bathe K. J., Finite Element Procedure, Prentice-hall of India, New Delhi, 1997.

2nd SEMESTER

CV3916	Lab : Finite Element Method		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**		**ESE Duration**
	-----	**40**	**60**	**100**		-----

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students the academic environment to conduct a structural analysis using finite element software 2. To motivate the students to use the modern tools and software. 3. To provide the students the basic skills in using commercial finite element software and effective presentation of their analysis results. 4. To provide the students the knowledge of finite element method for the analysis of structural engineering problems and their solution.	1. An ability to identify the information required to conduct a structural analysis using finite element software 2. An ability to interpret the solutions obtained from finite element analyses. 3. An ability to have basic skills in using commercial finite element software and effective presentation of their analysis results. 4. An ability to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.
PO Mapped: 2, 3, 4,	

Minimum **Six** practical based on theory syllabus

1. Analysis of 2D truss
2. Analysis of Bar subjected to various loading conditions
3. Analysis of beam subjected to various loading conditions
4. Analysis of Plane Stress problem (Plate, Plate with hole) using triangular & Quadrilateral element
5. Analysis of Plain Strain problem (Retaining wall, Culvert) using triangular & Quadrilateral element
6. Analysis of Axisymmetric problem (Cylinder, foundation) using triangular & Quadrilateral element
7. Analysis of 3D beams (Cantilever and Simply Supported) subjected to various loading conditions

2nd SEMESTER

CV3917	Theory of Plates and Shells		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVES	COURSE OUTCOMES
1. To impart knowledge of plate and shell behavior under different loading and boundary conditions. 2. To demonstrate use of classical, approximate and numerical methods to solve plate and shell problems.	After the completion of the course, the student should be able to 1. Demonstrate behavior of various plates 2. Analyze plates using different methods 3. Explain various theories of shells 4. Evaluate structural actions of shells using various theories
PO Mapped: 3,4	

UNIT – I Development of governing differential equations by Kirchoff's theory with reference to thin rectangular plates with various boundary conditions. Symmetrical bending of laterally loaded circular plates with different boundary conditions.	**[07 Hrs.]**
UNIT- II Study of Simply supported plates under different loadings. Navier's solution. Introduction to Levis solution.	**[06 Hrs.]**
UNIT – III Application of finite difference method to plate problem.	**[06 Hrs.]**
UNIT – IV Classification of Shells. Membrane theory of cylindrical shells with different directrix such as circular, cycloidal, catenary, and parabolic.	**[07 Hrs.]**
UNIT – V Bending theory of cylindrical shells, Finster walder, Schorer's, and D-K-J theory.	**[06 Hrs.]**
UNIT – VI Approximate analysis of cylindrical shells by beam method.	**[07 Hrs.]**

Text Books

1. Timoshenko S.P and Krieger S.W, Theory of Plates and Shells, 2nd Edition, McGraw-Hill Book Company, New Delhi, 1970.
2. Chadrashekhara K, Theory of Plates, 1st Edition, Universities Press (India) Ltd, Hyderabad, 2001.
3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

Reference Books

1. Ramachandran S., Thin Shells (Theory and Problems) 1st Edition, Universities Press (India) Ltd, Hyderabad
2. Szilard R., Theory and Analysis of Plates, Prentice Hall Publication, 1974.
3. Philipee G Ciarlet, Mathematical elasticity Vol.II: Theory of plates, 1st Edition, Elsevier Science B V, 1997

2nd SEMESTER

CV3918	Advanced Steel Structures		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
After completion of syllabus students will able 1. To understand basic principles of reliability-based design on steel structures 2. To understand the effect of natural phenomenon (wind and or earthquake), for structural engineering applications 3. To have an experience in the complete analysis and design of advanced steel structures like, Industrial Structure, Storage Tank, Truss Bridge and Tower	1. An ability to understand the configuration (component of structures, civil\structural engineering drawing etc.) of the structure. 2. An ability to understand the effect of natural phenomenon (wind and earthquake), in structural engineering applications 3. An ability to analyze and design the advanced steel structures by applying the provision of Indian Standard Code
PO Mapped: 1,6	

UNIT – I Design of roof truss of industrial structure.	**[07 Hrs.]**
UNIT- II Design of gantry girder, plate girder of industrial Structure.	**[06 Hrs.]**
UNIT – III Design of elevated storage tank.	**[07 Hrs.]**
UNIT – IV Design of staging of elevated storage tank.	**[06 Hrs.]**
UNIT – V Design of Truss Bridges.	**[07 Hrs.]**
UNIT – VI Design of Chimney.	**[06 Hrs.]**

Text Books:

1. Arya A.S and Ajmani J.L. Design of Steel Structures, Nemchand & bross, Roorkee
2. Duggal S.K., Design of Steel Structures, Mc Graw Hill publication, 2007
3. Dayaratnam P., Design of Steel Structures, Wheeler Publications, Allahabad, 1992
4. N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, ISBN 978-81-204-1741-0, Fourth edition, 2010.

Reference Book :

1. Ram Chandra Design of Steel structures Vol-I & Vol-II Std. book house / Rajsons Publication Pvt. Ltd.,, Delhi, 2006
2. Gaylords, E.H. & Gaylords, C. N., Design of Steel Structures, Blackwell, 1994.
3. Ghosh, "Analysis and Design practice of Steel Structure", (Forthcoming), Phi Publisher, New Delhi

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2nd SEMESTER

CV3919	Lab: Steel Design Studio		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**		**ESE Duration**
	-----	**10**	**60**	**100**		-----

COURSE OBJECTIVE	COURSE OUTCOMES
After completion of syllabus students will able 1. To provide basic knowledge of steel structural design and apply its principles to design steel structures. 2. To analyze and design the steel structures using software. 3. To present the analysis and design results in schematic way of the desired structure	1. An ability to apply the basic knowledge of structural steel. 2. An ability to develop the model (structure) in commercially available software, analyze and design it by applying appropriate loads. 3. An ability to present the analysis and design results in schematic way of the desired structure
PO Mapped: 1,6	

SN	Solve Any Four
1	Analyze and design the beam for TWO-point load moving on it.
2	Analyze and design the beam for THREE-point load moving on it.
3	Analyze and design the members of the roof truss of industrial structure.
4	Analysis and design of building structure for gravity load
5	Analysis and design of building structure for gravity &wind load.
6	Analysis and design of truss bridge.

Text Books:

1. Arya A.S and Ajmani J.L. "Design of Steel Structures", Nem Chand & Bros, Roorkee.
2. Duggal S.K., "Design of Steel Structures", Mc Graw Hill publication, 2007
3. Dayaratnam P., "Design of Steel Structures", Wheeler Publications, Allahabad, 1992.
4. N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, ISBN 978-81-204-1741-0, Fourth edition, 2010.

Reference Book :

1. Ram Chandra, "Design of Steel structures", Vol-I & Vol-II, Std. Book House, Raj Sons Publication Pvt. Ltd., Delhi, 2006
2. Gaylords, E.H. & Gaylords, C. N., "Design of Steel Structures", Blackwell, 1994.
3. Ghosh, "Analysis and Design practice of Steel Structure",Phi Publisher, New Delhi

2nd SEMESTER

CV3920	PE-I : New Engineering Materials		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To understand various civil engineering materials 2. To understand various methods of testing of materials 3. To understand and use various codes related to the civil engineering materials	1. An ability to introduce different high quality materials for civil engineering applications. 2. An ability to use engineering materials for better and durable Civil Engineering Structures.
PO Mapped: 1,2	

UNIT-I Steel fiber reinforced concrete, Properties, Aspect ratio, strength and durability.	**[06 Hrs.]**
UNIT-II Fiber reinforced plastics, other types of fibers and their applications.	**[07 Hrs.]**
UNIT-III Light weight concrete, foam concrete, fly ash concrete, workability, durability, and application.	**[06 Hrs.]**
UNIT-IV High-grade concrete, high strength performance concrete, trimix concrete.	**[07 Hrs.]**
UNIT-V New engineering materials like light weight steel profile, aluminum profile, pressed steel sections.	**[06 Hrs.]**
UNIT-VI Introduction to steel concrete composite including infill, encased section, properties of shear connectors, use of IS: 11384, IRC 22.	**[07 Hrs.]**

Text books:

1. Neville A. M., Properties of Concrete, Pearson Education Limited.
2. Rafat Siddequi , Special Concretes, Galgotia Publications.
3. M Gambhir, Concrete Technology, Tata Mcgraw Hill Education Private Limited.

Reference books:

1. Mehta P, Concrete Technology, Tata Mcgraw Hill Education Private Limited.
2. Shetty M. S, Concrete Technology, S. Chand Publisher.

2nd SEMESTER

CV3921	PE I : Prestressed Concrete		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVES	COURSE OUTCOMES
1. To understand the basic concepts of prestressed concrete. 2. To study various devices used for Prestressing. 3. To analyze and design the basic structural members in Prestressed concrete 4. To analyze and design the special structures like Prestressed Concrete Pipes, Liquid Storage Tanks and Ring Beams	1. Students will be able to apply basic concepts of prestressed concrete in construction industry. 2. Students will be able to identify, formulate and solve engineering problems pertaining to prestressed concrete. 3. Students will be able to Understand IS codes related to prestressed concrete. 4. Students will be able to design special prestressed concrete structures.
PO Mapped: 1,3,4,6	

UNIT–I Introduction to prestressed concrete, types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads.	**[06 Hrs.]**
UNIT–II IS1343 – 2012 codal provisions, Limit state of collapse and serviceability for analysis and design of rectangular, I and box sections for flexure and shear, control of deflection.	**[07 Hrs.]**
UNIT–III Transmission of pre-stress in pre-tensioned members; Anchorage zone stresses for post-tensioned members. Introduction to statically indeterminate structures, redundant reactions, linear transformation and concordancy.	**[07 Hrs.]**
UNIT–IV Analysis and design of continuous beams, Choice of cable profile.	**[06 Hrs.]**
UNIT–V Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage, deflection effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations	**[07 Hrs.]**
UNIT–VI Analysis and design of prestressed concrete slabs – one way and two way Introduction to prestressed concrete pipes, tanks, flat slabs, grids, railway sleepers (No numerical problems).	**[06 Hrs.]**

Text Books:

1. N. Krishnaraju, Prestressed Concrete, 3rd edition, Tata McGraw Hill Publishing Co., 2004
2. S.K. Mallick and A.P.Gupta, Prestressed concrete, Oxford and IBH Publishing Co., New Delhi.
3. Praveen Nagarajan, "Prestressed Concrete Design", PEARSON Publishing Co., Delhi, 2013
4. K.U.Muthu, Azmi Ibrahim, Maganti Janardhana, M. Vijayananad, " Prestressed Concrete", PHI Learning Pvt. Ltd., Delhi 2016

Reference Books:

1. Lin, T.Y. and Burns, N.H. , Design of Prestressed Concrete Structures, , 3rd edition, John Wiley &Son's, 2004
2. IS : 1343 – 2012, Code of Practice of Prestressed Concrete, Indian Standards Institution.
3. Guyon Y., Prestressed Concrete vol.I and II, Contractors Record Ltd., London.
4. Abels P.W., An Introduction to Prestressed Concrete, Vol.I and II', Concrete Publications Ltd., London.
5. DayaratnamP. ,Prestressed Concrete Structures, , 5th edition, Oxford & IBH, 1996

2nd SEMESTER

CV3922	PE I : Smart Structures and Applications		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To understand smart system 2. To understand characteristics and behavior of smart materials 3. To understand control system and its applications 4. To understand techniques of base isolation	1. An ability to understand passive and active systems. 2. An ability to understand the characteristics and behavior of smart materials 3. An ability to understand control system and its applications 4. An ability to understand techniques of base isolation
PO Mapped: 3,4	

UNIT-I Introduction to smart structures, application, smart systems –Components of smart systems, different types smart materials – characteristics and behavior of smart materials – modeling of smart materials.	**[07 Hrs.]**
UNIT-II Introduction of sensors and actuators., features and - characteristics of sensors-types of sensor and actuators- electronic, thermal and hydraulic type actuators ,characteristics of sensors and actuators.	**[06 Hrs.]**
UNIT-III Overview of structural health monitoring ,smart application to new and existing buildings ,Advantages and limitations	**[07 Hrs.]**
UNIT-IV Theory of Vibration Isolation: Principle of base isolation ,Methods, Techniques	**[06 Hrs.]**
UNIT-V Energy dissipation devices; introduction ,Methods, principals	**[07 Hrs.]**
UNIT-VI Types of energy dissipation devices; Metallic yield dampers, friction dampers, viscoelastic dampers, tuned mass dampers.	**[06 Hrs.]**

References Books

1. Srinivasan, A.V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2000.
2. Yoseph Bar Cohen, Smart Structures and Materials 2003, The International Society for Optical Engineering 2003.
3. Brian Culshaw, Smart Structures and Materials , Artech House, Boston, 1996.
4. M.V.Gandhi and B.S.thompson, Smart Materials and Structures , Chapman and Hall 1992

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2nd SEMESTER

CV3923	PE II : RC Tall Buildings		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To understand earthquake load acting on a building and design the building for above loading by providing shear walls 2. To understand various aspects of high rise buildings such as the effect of torsion, soft storey effect, p- delta effect and drift index. 3. To understand detailing of RCC members for ductile behavior as IS Code provisions	1. The students will be able to describe fundamental concept, principle and application of earthquake engineering. 2. The students will be able to analyze and design RCC structures with ductile detailing as per Indian standards. 3. The students will be able to apply technical design principles and techniques such as P-delta effect, soil structure interaction for a design of high rise structures. 4. The students will be able to apply various provisions for earthquake resistance design of structures as per Indian standards.
PO Mapped: 1,2,3,4,6	

UNIT-I Earthquake & wind load calculations along with dead load and live loads and their Combinations as per IS code.	**[06 Hrs.]**
UNIT-II Introduction to Frame – shear wall buildings, Mathematical modeling of buildings with different Structural systems. Analysis & Design of shear walled buildings with ductile detailing as per IS 13920-2016	**[06 Hrs.]**
UNIT-III Special aspects in Multi- Story buildings like effect of torsion, flexible first storey, P- delta effect, Soil – Structure Interaction on building response, drift limitations.	**[07 Hrs.]**
UNIT-IV Ductility of reinforced members subjected to flexure. Design of braced columns using codal provisions.	**[06 Hrs.]**
UNIT-V Analysis and Design of multi-storeyed buildings with bracings & masonry in fills, Beam – column jointed for ductile behaviors.	**[07 Hrs.]**
UNIT-VI Introduction to Diaphragm. Seismic Design of Floor Diaphragm.	**[06 Hrs.]**

Text Books:

1. Agrawal P. & Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4th Edition, 2007.
2. Verghese P.C., Advance Reinforced Concrete Design, Prentice hall of India, New Delhi, 2001
3. S.K. Duggal , Earthquake – Resistant Design of Structures , Oxford university Press second edition 2013
4. Reinforced concrete design of Tall building by Bungale s. Taranah. 1st Edition Kindle Edition.

Reference Books:

1. Park, R. &Paulay, T., Reinforced Concrete Structures, John Willey & Sons; 2nd Edition, 1975
2. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition, 1999
3. FarzadNaeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
4. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

2nd SEMESTER

CV3924	PE II : Composite Structures		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the student knowledge of basic concepts and characteristics of Composite materials 2. To provide the student the knowledge of behavior of lamina 3. To provide the student with knowledge of various failure theories 4. To provide students the knowledge of analysis of laminated plates under bending and vibration.	1. Students will be able to understand basic concepts and characteristics of Composite materials. 2. Students will be able to understand elastic behavior of lamina. 3. Students will be able to understand various failure theories. 4. Students will be able to analyse laminated plates under bending and vibration.
PO Mapped: 1,3,4,6	

UNIT-I Introduction: definition, Classification and characteristics of Composite materials, advantages and limitations. Current Status and Future Prospects; Basic Concepts and characteristics: Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy;	**[07 Hrs.]**
UNIT-II Characteristics and configurations of lamina, laminate, micromechanics and macro-mechanics. Constituent materials and properties; Elastic behavior of unidirectional lamina: Anisotropic, separately orthotropic and transversely isotropic materials,	**[06 Hrs.]**
UNIT-III stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, Strength of unidirectional lamina.	**[07 Hrs.]**
UNIT-IV Macro-mechanical failure theories- Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu)	**[07 Hrs.]**
UNIT-V Elastic Behavior of multidirectional laminates: Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties.	**[06 Hrs.]**
UNIT-VI Bending and vibration of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, especially orthotropic, anti-symmetric cross-ply laminates. Recent advances: Functionally graded materials, Smart materials.	**[06 Hrs.]**

Text / Reference Books:

1. R.M. Jones, Mechanics of Composite materials, Taylor and Francis, 1999.
2. M. Daniel and O. Ishai, Engineering mechanics of Composite materials, Oxford university press, 1999
3. P.K. Mallick, Fiber-reinforced Composites, Marcel Dekker Inc, 1988.
4. D. Hull and T.W. Clyne, An introduction to composite materials, Cambridge university press, Second Edition, 1996.
5. J.N. Reddy, Mechanics of laminated composite plates and shells-Theory and Analysis, CRC Press, BocaRaton, Second Edition, 2003.

2nd SEMESTER

CV3925	PE II : RC Bridge Design		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs ***	**TA**	**ESE**	**Total**		**ESE Duration**
	30	**10**	**60**	**100**		**3 Hours**

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students clear and through understanding of various types of bridges and loadings. 2. To provide the students the knowledge of design philosophy for bridges and its components. 3. To provide understanding of earthquake behavior and design philosophy for retaining wall and abutments.	1. An ability to identify the types of bridge to be used for various site and loading conditions. 2. An ability to understand applicability of IRC codes related to bridges. 3. An ability to analyze and design slab bridges and its components.
PO Mapped: 1,2,3	

UNIT – I Types of RC bridge superstructure and introduction to their design, choice of type of bridges.	**[07 Hrs.]**
UNIT – II IRC Loads, Analysis of IRC Loads, Impact factors, Other loads to be considered in Bridge Design.	**[08 Hrs.]**
UNIT – III Reinforced concrete solid bridge, Effective width method, Dispersion length.	**[07 Hrs.]**
UNIT – IV Seismic design philosophy for Bridges, Capacity design concept. Behavior Retaining wall.	**[08 Hrs.]**
UNIT – V Abutments, Stability Analysis of Abutments, Piers, Analysis of Piers.	**[08 Hrs.]**
UNIT – VI Bearings, Forces on Bearings, Types of Bearings, Basis for Selection of Bearings.	**[08 Hrs.]**

Text Books:

1. N. Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
2. D. Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
3. Jagdeesh R. and Jairam M., " Design of bridges", PHI Publication New Delhi, 2nd edition,

Reference Books

1. IRC: 5 -1970, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.
2. IRC 006, Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses (Fourth Revision), 2014.
3. Chen, W.F. and Duan, L., Bridge Engineering Handbook, CRC Press, 1999
4. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 1962.
5. Hambly, E.C., Bridge deck behaviour, Chapman and Hall, London
6. O'Brien E.J. and Keogh D.L., Bridge deck analysis, E& FN Spon, New York

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2nd SEMESTER

CV3926	PE III : Plastic Analysis & Design of Steel Structure	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
After completion of syllabus students will able to Understand behavior of steel structural members beyond yield point, understand the theories of plastic analysis and will be able to design steel structures considering plastic design approaches	1. An ability to understand behavior of steel structure elements beyond yield point loading and basic concepts of plastic analysis. 2. An ability to understand techniques for estimation of collapse loads on steel structures 3. To understand the effects of axial and shear forces on plastic moment of resistance 4. To understand philosophies of plastic design of steel structural elements
PO Mapped: 3,4	

UNIT I: Plastic behavior, review curves of structural steel, plastic moments, shape factors, load factors, plastic hinge, types of collapse, collapse mechanism, collapse load factor, step by step method.	**[07 Hrs.]**
UNIT II: Upper and lower bound, uniqueness theorem, principle of virtual work, statical method, minimum and maximum theorems, Determination of collapse load factor for beams and portal frames.	**[07 Hrs.]**
UNIT III: Methods of release of restrains, load interaction diagrams, method of inequalities.	**[06 Hrs.]**
UNIT IV: Plastic Moment distribution applied to continuous beams & portal frames (Max. two bays single storey)	**[06 Hrs.]**
UNIT V: Effect of Axial force & Shear force on Plastic moment of resistance, Design of simply supported and continuous beams.	**[07 Hrs.]**
UNIT VI: Design of portal frames up to single storey – two bays. Minimum weight design.	**[06 Hrs.]**

Text Book:

1. Steel Skeleton, J. F. Baker, Volume II, Cambridge University Press 196
2. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall

Reference Books:

1. "Limit state Design of Steel Structures", S K Duggal , McGraw Hill education, 2010
2. "Limit State Design of Steel Structures", Dr. M R Shiyekar, PHI Publication, 3rd Print
3. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand& Bros., Roorke
4. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
5. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons
6. Structural design in steel by SalwarAlamRaz New Age International Publishers 15/44
7. Steel Designers Manual – ELBS

General Reading Suggested:

1. Codes: IS: 800 - 2007 Code of Practice for General Construction in Steel Hand books
2. SP: 6 (6) – 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures
3. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1993) – Bureau of Indian Standards.
4. NPTEL
5. Teaching Resource for Structural Steel Design – INSDAG Kolkatta

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2nd SEMESTER

CV3927	PE III : Seismic Analysis and Design of Structures	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students clear and through understanding of the basic concepts of earthquake resistance design. 2. To provide the students clear and through understanding of analysis and design aspects of RCC and steel members subjected to earthquake loads. 3. To provide the students clear and through understanding of detailing of RCC and steel members for ductile behavior. 4. To provide the students clear and through understanding of various Indian codes related to earthquake engineering.	1. An ability to apply basic concepts Earthquake resistant design in construction industry. 2. An ability to identify, formulate and solve engineering problems pertaining to earthquake effects on structures. 3. An ability to understand IS codes related to static as well as dynamic analysis of high rise buildings. 4. An ability to design special structures subjected to more effective earthquake forces.
PO Mapped: 3,4	

UNIT - I Performance of RC buildings, behavior of RC buildings in past earthquakes, influence of unsymmetry, infill walls, foundations, soft story, confinement of concrete.	**[07 Hrs.]**
UNIT - II Review of IS 1893:2016 Part I -Capacity Based Design concept - Design for Strong column & weak beam, Design of Beam-Column Joints.	**[06 Hrs.]**
UNIT - III Behavior and failures of RC beam and recommendation for it -capacity design of RC Beam.	**[06 Hrs.]**
UNIT - IV Analysis & Design of shear walled buildings with ductile detailing as per IS 13920-2016.	**[06 Hrs.]**
UNIT - V Performance of steel structures in past earthquakes-Seismic behavior of steel structures - design philosophy for steel structures, Basics of Steel Design.	**[07 Hrs.]**
UNIT - VI Capacity design concept, Ductility of steel buildings- Stability considerations.	**[07 Hrs.]**

Text Books:

1. Agrawal P. & ,Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4th Edition, 2007.
2. Agrawal P. &, Shrikhande M., Earthquake Resistant Design of Structures, PHI Publisher, New Delhi.
3. Bruneau, M.; Uang, C.M.; & Whittaker, A Ductile Design of Steel Structures McGraw Hill.
4. Mazzolani, F.M.; &Piluso Theory and Design of Seismic Resistant Steel Frames E&FN Spon

Reference Books:

1. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition, 1999
2. Farzad Naeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
3. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

2nd SEMESTER

CV3928	PE III : Design of Industrial Structures	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

MSEs = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To afford the knowledge of various aspects of industrial structures, analysis of loads on industrial structure. 2. To convey the knowledge of analysis and design of large span structures. 3. To drill the importance of prefabricated and precast structures as applied to concrete, RCC and structural steel 4. To deliver the knowledge of stability of silos and bunkers under dynamic loads. 5. To provide the knowledge of analysis and design of foundations for industrial structures	1. An expertise to understand planning of industrial structures. 2. The capability to analyse large span structures. 3. An expertise to understand stability of silos and bunkers under dynamic loads. 4. The skill to analyse and design foundations for industrial structures.
PO Mapped: 1,6	

UNIT-I: **PLANNING OF INDUSTRIAL STRUCTURES :** Classification of industries and local regulations - Factors affecting planning - General Aspects – Civil Engineering Aspects - Light and Ventilation.	**[06 Hrs.]**
UNIT-II: **ANALYSIS OF LOADS** Analysis of dead load; imposed load and wind load on industrial structure, Introduction to earthquake forces.	**[07 Hrs.]**
UNIT-III **PRE-ENGINEERED AND PRECAST STRUCTURES** Prefabricated construction; necessity, advantages, disadvantages, prefabricates classification; foundation, columns, beams, roof and floor panels, wall panels, box prefabricates, erection and assembly.	**[06 Hrs.]**
UNIT-IV: **LARGE SPAN STRUCTURES IN INDUSTRIES** Cable roofs, types of cable roofs, Analysis of a cable subjected to concentrated loads and uniformly distributed load, Overview of deep beams, Virrendel Girder, Castellated Girders	**[07 Hrs.]**
UNIT-V **SILOS AND BUNKERS** Concept of Angle of Repose, Pressure distribution, Dynamic loads, Stability of bunkers, Foundations.	**[06 Hrs.]**
UNIT-VI: **FOUNDATIONS FOR INDUSTRIAL STRUCTURES** Machine foundations, General requirements, Design criteria, General analysis, Design of a block foundation for vertical compressor, Vibration Isolation, Foundations for Chimney and Microwave Towers.	**[07 Hrs.]**

Text books:

1. Srinivasula P.,"Hand Book of Machine Foundation", Tata Mc. Graw Hill Publications, New Delhi. First Edition, 2000
2. Ramchandra, "Design of Steel Structures", Standard Book House, New Delhi Seventh Edition, 2000
3. Raghupati M., "Design of Steel Structures", Tata Mc. Graw Hill Publication, Delhi First Edition, 2003
4. Dayaratnam P.< "Design of Steel Structures", Wheelr's Publishers, Allahabad1995
5. AnandArya&Ajmani J. L., "Design of Steel Structures", Nemchand& Bros., Roorkee, U.P., India, Forth Edition, 2004
6. Lambert F.W., "The Theory & Practical Design of Bunkers", British Constructional Steelwork Association Ltd., London, UK2000
7. Hass, A.M., "Precast Concrete, Design and Applications", *Taylor & Francis, UK.*
8. Phillips, W.R. and Sheppard, D.A., "Plant cast, Precast and Prestressed Concrete", McGraw Hill,New York.

3rd SEMESTER

CV3939	Project Phase - I		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**MSEs** *	**TA**	**ESE**	**Total**	**ESE Duration**	
	-----	**100**	-----	**100**	-----	

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering 2. To motivate the students to use the modern tools and software. 3. To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	1. An ability to understand the advances in structural engineering. 2. An ability to understand the use of modern tools. 3. An ability to work independently and in a team for effective communication 4. An ability to understand the importance of lifelong learning.
PO Mapped: 1, 2, 3, 4, 5, 6,	

Contents:

1. Literature review on current topic related to the structural engineering.
2. Preparation and presentation of progress seminars on topic selected for dissertation.
3. Submission of project report including introduction, literature review, objective and scope of investigation and pilot studies carried out during the semester.

4th SEMESTER

CV3940	Project Phase - II	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs *	TA	ESE	Total	ESE Duration
	-----	40	60	100	-----

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering. 2. To provide the students the understanding of real world structural engineering problems and their solution. 3. To motivate the students to use the modern tools and software. 4. To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	1. An ability to understand the advances in structural engineering. 2. An ability to solve real world structural engineering problems. 3. An ability to understand the importance of lifelong learning and the use of modern tools. 4. An ability to work independently and in a team for effective communication.
PO Mapped: 1, 2, 3, 4, 5, 6,	

Contents:

1. The of detailed study of a work including collection and analysis of data, determining solution, design, scientific research on topic selected for dissertation.
2. Preparation and presentation of progress seminars on topic selected for dissertation.
3. Submission of project report on the entire studies carried out during the semester